A New Genus of Fresh-water Isopoda, allied to Phreatoicus.

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The specimens, upon which the following description is based, were first taken by one of us on the occasion of an excursion made by members of this Society to the Lesmurdie Falls in the Darling Range, on August 11, 1923. Prior to this date there had been a period of prolonged and very heavy rainfall, and water was welling up strongly from numerous springs and soaks. Some twenty specimens, including one female, were taken in a small pool a few inches deep and less than a square yard in area, supplied by a small spring just below the falls.

A fortnight later, when the spot was revisited after a dry period, only about half a dozen in all were obtained, although a careful search was made. The search was extended to the entire hillside, and included numerous pools formed by the many winter soaks, but failed to reveal the animal in any other place. Its bleached appearance, blind condition and elongated shape suggest that it is a subterranean form which gets carried from crevices underground by the rush of water during the rainy season. It appears to be able to hold on strongly but is unable to swim, though walking well and quickly. Sayce's account (1899) of the related form *Phreatoicoides* suggests that it, too, might be a subterranean form washed out from underground and collecting in similar pools where the slight damming up of water enables some to escape being swept away into the swifter running stream. No member of the family *Phreatoicidae* had been recorded from Western Australia until a few months ago, when a description of an undoubted *Phreatoicus* was read before this Society by Glauert (1923). The specimen now described, while agreeing in many important respects with that form is, in other features, clearly intermediate between that genus, *Hypsimetopus* and *Phreatoicoides,* and not to be assigned to any of these. Associated with it were two small Amphipods, not yet identified, which also occur quite sparingly.

HYPEROEDESIPUS gen. nov.

Body long, sub-cylindrical, slightly compressed. Cephalon relatively large, slightly deeper than the first free segment. This is much shorter than the succeeding segments, which are sub-equal in length. Pleon distinctly shorter than in *Phreatoicus,* but not so short as in *Hypsimetopus,* and half as long again as in *Phreatoicoides;* pleura scarcely produced, the pleopods entirely exposed.

Upper antenna short; lower antenna long, with flagellum. Mandible with an appendage. First peraeopod terminates in a subchelate hand in both sexes; in the male this is of moderate size and bears upon its dorsal surface a well-developed projection, absent from the smaller hand of the female. Exposed pleopods intermediate in form between those of *Phreatoicoides* and *Hypsimetopus*, being much narrower than those of the latter and shorter than those of the former. Epipodites absent from 3rd, 4th and 5th pleopods. The tail-piece, formed by the united telson and last pleon segment, is relatively long and distinctly constricted off from the fifth pleon segment. Uropods as long as the tail-piece and projecting well behind posterior margin of telson. Telson truncate.

Remarks. Most nearly resembling *Hypsimetopus* in the general form of the body, it differs markedly from that genus in a number of particulars. In the proportions of cephalon and first segment it agrees much more nearly with *Phreatoicus* (*P. australis*). The constriction between 5th and 6th pleon segments is much more marked than in *Hypsimetopus* but much less than in *Phreatoicoides*. It agrees with the latter, however, in the absence of epipodites.

Hyperoedesipus may readily be distinguished from *Phreatoicus* and *Phreatoicopsis* by the exposed condition of the pleopods. It differs from both of these and from *Hypsimetopus* in the absence of epipodites from the last three pairs of pleopods. From *Hypsimetopus* and *Phreatoicoides* it differs in the extreme narrowness of the first free segment. It may further be distinguished from *Phreatoicoides* by the much greater proportional length of the pleon and the shape of the mature grasping hand in the male. Plumose setae, so abundantly present in *Hyperoedesipus*, are said to be altogether absent in *Phreatoicoides*.

In the sum of its characters, therefore, *Hyperoedesipus* seems to occupy a position near to *Phreatoicus* (*P. australis*) but intermediate betwen that genus and *Hypsimetopus* and *Phreatoicoides*. Reference to the table appended will serve to make clear these several resemblances and differences.

Hyperœdesipus plumosus. sp. nov.

Specific diagnosis. Body slender, sub-cylindrical, slightly compressed, surface smooth with sparsely scattered setae. Eyes not formed. Pleura of pleon scarcely produced, their inferior margins fringed with small spiniform setae. Taking cephalon and peraeon as 100, the pleon and telson measure 53. Fifth segment of pleon about half the length of the anterior four. Sixth pleon segment deeper than those preceding and measuring more than half the length of the five anterior segments.

Upper antennae of 7-8 joints less in length than peduncle of lower antennae. Lower antennae about half length of body, peduncle of five joints, first two short and sub-equal, third and fourth longer, fifth as long as the two latter combined. Flagellum of 21-27 segments. Legs long and slender, the posterior series of three approximately 1⅓ the length of those in anterior series. First pair of peraeopods sub-chelate, largely developed and, in the mature male, with a notable projection upon anterior surface. Telson truncate. Uropoda with the peduncles stretching considerably beyond the telson, rami not as long as peduncle, the inner one longer than the outer and slightly curved inwardly. Plumose setae abundantly developed on the pleopods.

Colour whitish, the animal translucent, the intestinal tract being clearly visible through the transparent body wall.

Length—male 10 mm. Female with brood pouch (only one specimen taken), 6 mm.

Habitat. Found sparingly in a pool of a square yard or less in extent, fed by a spring and situate just at the foot of the Lesmurdie Falls, in the Darling Range, W.A.

Detailed Description. The male specimens which were examined varied in length from 7 mm. to 10 mm., the female with eggs in incubatory pouch measured 6 mm. In both sexes the body is subcylindrical and practically of uniform breadth and depth throughout the whole length. The pleon is but slightly deeper than the peraeon, the pleura in this region being extremely short and not appreciably produced to protect the pleopods. The surface of the body is smooth with sparsely scattered setae. Specimens preserved in spirit undergo a certain contraction whereby the softer intersegmental regions are concealed.

Head. The head (Pl. II, 1b) is much longer than the following segment, slightly deeper and somewhat wider. The dorsal surface is convex and curves down antero-laterally, presenting a concave surface for articulation with the mandible. There is no trace of the eyes and but few setae occur on the dorsal surface.

Peraeon. This consists of seven segments, not all of equal size (Pl. II, 1a). The first free segment being less than half as long as the second, while the succeeding segments are subequal. Setae occur sparsely on all the segments and fringe the inferior margins. They are scattered singly and do not occur in tufts as is the case in some species of *Phreatoicus.*

Pleon. The five anterior segments are distinct but the sixth is so completely fused with the telson as to be indistinguishable (Pl. II, 1a). Segments 1-4 are quite short, being less than half the length of a peraeon segment. The occurrence of very narrow pleura

makes them slightly deeper than the peraeon segments, each pleuron extending slightly downward and posteriorly, to overlap the succeeding segment, but they are quite insufficient to conceal the pleopods. Their inferior borders are convex and sparsely fringed with spinules. The fifth segment is approximately twice as long as the preceding segment and its anterior border is equal to that in depth but the pleura on this segment are better developed and give to it a fictitious depth, serving to conceal largely the distinct constriction between segments five and six. The united telson and sixth segment form the "tail-piece" (Pl. V, 10, 11). Its dorsal margin is slightly convex. In lateral view it is seen to turn abruptly, almost vertically downward and the posterior margin, for about half the depth of the segment, is nearly straight. Seen from above, it presents a convex outline, deeply notched (Pl. V, 11) in the middle line, the indentation marking the position of the anus which is terminal. The inferior margin, which is nearly straight for about three-fourths of the length of the segment, is bent upwards nearly vertically for approximately one-third of the height of the piece, at the articulation of the uropod. Posteriorly to the insertion of the uropods the convex inferior margin of the tail-piece curves gently upwards to meet the posterior margin somewhat obtusely. The whole surface is sparsely set with setae.

Tail-piece. This, with the uropods, differs both in relative size and in shape from the corresponding structures of any of the existing allied genera (fig. 1). The very obvious constriction at its

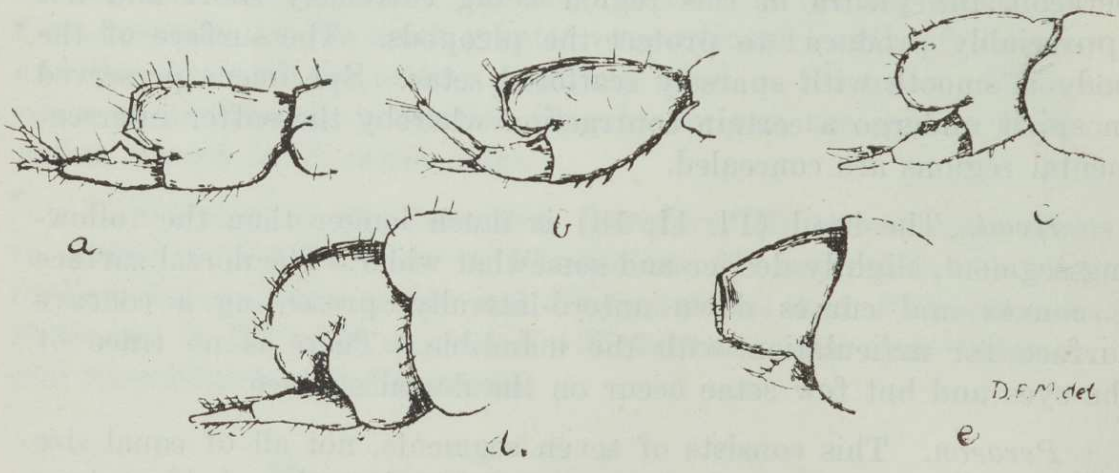

Fig. 1.

anterior margin distinguishes *Phreatoicoides* (fig. 1b); *Phreatoicus* (1d) and *Hypsimetopus* (1c) are marked by the possession of a telson of sub-conical form, while in *Phreatoicopsis* (1e) the telson is abruptly truncate and is further peculiar in the relative shortness of the uropods. *Hyperoedesipus* (1a) lacks all of these distinctive characteristics but seems most nearly to approach the condition of *Phreatoicoides*.

First antennae. (Pl. IV, 3a.) These are short, not extending to the distal end of the peduncle of the second antennae. They are divided into sometimes eight, more often seven joints. The first joint is small and without setae, the second somewhat longer with one or two fine setae, and the third only slightly greater in length than the first joint and narrower than the second. The remaining joints show a gradual increase in length until the penultimate is reached, this being both longer and stouter than the second. The terminal joint is very small and forms a rounded knob. It bears a circlet or tuft of fine hair-like setae. On the other segments sensory setae occur but sparsely.

Second antennae. (Pl. IV, 3b.) These are about half as long as the body. The peduncle consists of five joints, of which the first two are short and sub-equal, the third and fourth longer, and the fifth as long as the two latter combined. Each joint is sparsely setose whilst from the distal end of the fifth segment springs a series of very long setae. The number of joints composing the flagellum is not constant, varying from as few as 21 to as many as 27. Almost invariably the number of these joints is different on the right and left side of the same specimen, the right in most cases possessing fewer joints than the left. The first joint of the flagellum is twice as long as the succeeding joints, which are equal in length but become more slender towards the extremity. At the distal end of many of these segments there is a circlet of short setae, the terminal joint bearing a tuft of three or four longer setae.

The *upper lip* (Pl. IV, 4) is relatively large and is slightly broader than long. Its distal margin is clothed with short fine setae and has a shallow median notch.

The *mandibles* do not appear to differ in any important respect from those of *Phreatoicoides*. As is usual, the mandibles of opposite sides are slightly dissimilar in the cutting edges. The left mandible (Pl. IV, 5) has two rows of teeth, the outer row consisting of four sharp and strong teeth, the inner row of four smaller teeth. A molar tubercle (*m.t.*) is well developed and, distal to it, is a short process set with eight stout setae, some of which are plumose. There is but a single row of four strong sharp teeth to the cutting edge of the right mandible.

The *lower lip* (Pl. IV, 8) is a short bilobed structure, broader and shorter than the upper lip. The lobes are not as distinct as in other *Phreatoicidae*, a slight concavity on the ventral margin alone separating them distally. The entire ventral margin is densely fringed with inwardly directed setae. A median ridge on the posterior aspect appears to be well developed; it is probably the homologue of a similar structure described by Chilton in *Ligia exotica*

(1916), but has apparently not been recognised in other *Phreatoicidae.*

The *first maxilla* (Pl. IV, 6) resembles in outline that of *Phreatoicoides* and *Phreatoicus australis.* It bears two lobes, the outer shorter and stouter with truncate end and fringed with short curved spines. On its outer border are a few setae. The inner lobe is more rounded distally and carries, at its extremity, four long plumose setae with which are mingled a number of simple setae.

The *second maxillae* (Pl. IV, 7) show a basal portion produced into a rounded lobe at the inner distal end. External to this are situate two lobes, similar to one another and somewhat longer than the inner lobe. The end of both of these is obliquely truncated and bears numerous pectinated curved setae as well as a number of long simple spiniform setae.

The *maxillipedes* (Pl. IV, 9) are large and similar to those of *Phreatoicoides.* The coxa bears laterally a large flat plate (epipodite) which does not extend as far as the distal end of the ischium. The basis is three times as long as broad and has attached to its inner margin an accessory flattened plate which reaches to the end of the merus. Its dorsal margin is closely set with fine setae, the more distal of which are pectinated. Ischium, merus, carpus and propod do not differ materially from the corresponding structures in *Phreatoicoides.* The dactyl, however, is rather swollen, ends bluntly and has both inner and outer margins convex.

First Peraeopods. In the male these form large well developed sub-chelate gnathopods (Pl. V, 12). The basis and ischium are subequal in length, narrowed at their junction with the following segment. A few long setae occur on the posterior distal margin of the basis; the ischium has two setae arising from the middle of the posterior and anterior borders. The merus, which is about half as long as the ischium, is sub-triangular in outline; distally it bears a number of long hair-like setae. The carpus is also sub-triangular in shape, the posterior margin in this case forming the base of the triangle. From this margin spring a couple of spiniform setae. The propod of the mature male is large and presents a very characteristic shape entirely distinct from the propod of any of the *Phreatoicidae* hitherto described. Its anterior margin is produced upwards, almost vertically, and stretches proximally more than half the length of the ischium forming a large swelling on the anterior border of the propod. In the immature male the anterior border is but slightly convex and curves distally to articulate with the dactyl. At its proximal end the posterior margin is convex and bears numerous stiff spiniform setae; distally its outline is concave and this part of the palm is almost bare of setae. The dactyl is actually longer than the propod

but much narrower and curves slightly inwards to terminate in a strong claw-like spine. Such a spine is figured in *Phreatoicoides* but not described; it does not appear in the figures of other genera of *Phreatoicidae*. A few short and stiff setae are scattered over the surface of the dactyl.

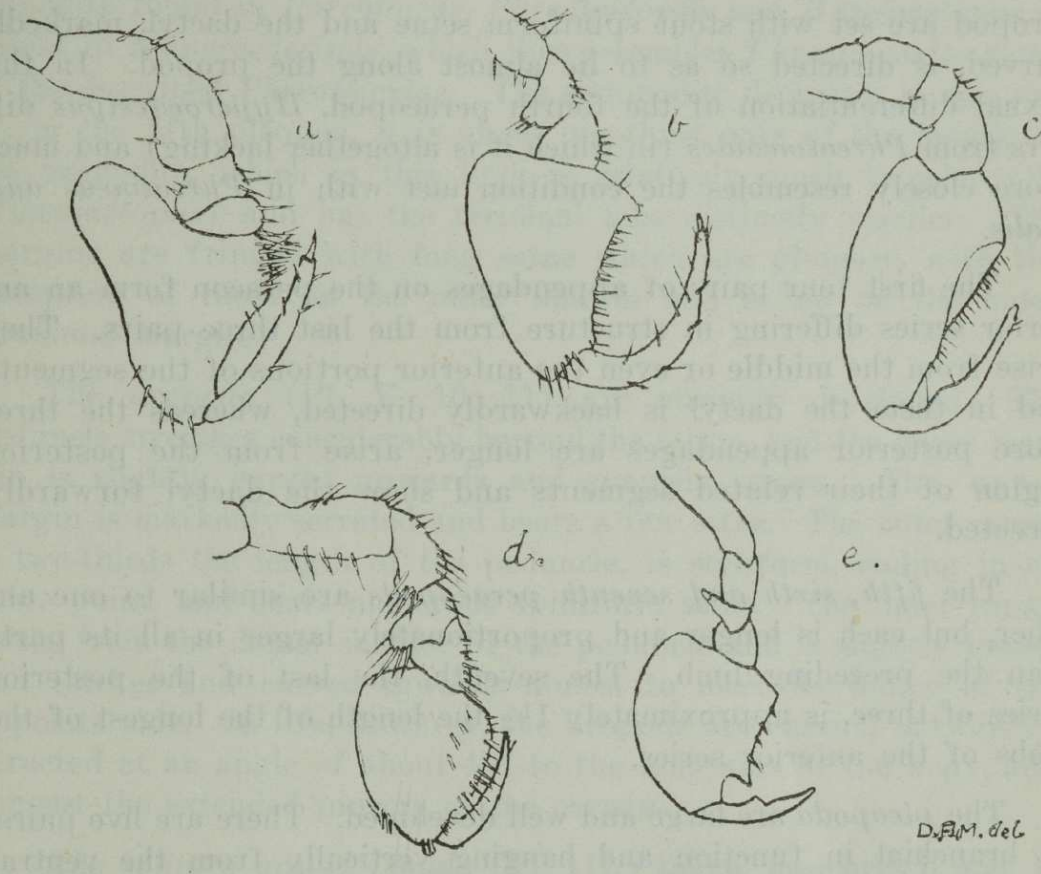

Fig. 2. First peraeopod of *Hyperoedesipus* (a); *Phreatoicoides* (b); *Hypsimetopus* (c); *Phreatoicus australis* (d); *Phreatoicopsis* (e).

In the female the parts of this limb are similar with the exception of the propod, which is smaller (Pl. V, 13), and lacks the notable swelling on the convex anterior margin. The palm is much more sparsely setose and the dactyl is shorter, not quite equalling the propod in length.

Second and third peraeopods. (Pl. V, 14.) The basis and ischium are similar to those of the first peraeopod and equal in length to the merus, but the latter is much more constricted proximally. Its anterior margin is produced at its distal end to overlap the carpus, the projection bearing several stout setae. The carpus is similar and sub-equal to the merus, a few setae arising from its posterior margin and a distal cluster from the anterior margin. The propod is sub-rectangular and is equal in length to the carpus but slightly narrower, with four or five setae posteriorly. Its anterior margin is but sparsely setose with a distal tuft. The short dactyl is borne

almost at a right angle to the propod and ends in a sharp tooth-like spine.

The *fourth peraeopod* bears a general resemblance to the second and third, but the segments are relatively shorter and the appendage is modified to form a grasping organ. The convex margins of the propod are set with stout spiniform setae and the dactyl, markedly curved, is directed so as to lie almost along the propod. In this sexual differentiation of the fourth peraeopod, *Hyperoedesipus* differs from *Phreatoicoides* (in which it is altogether lacking) and much more closely resembles the condition met with in *Phreatoicus australis*.

The first four pairs of appendages on the peraeon form an anterior series differing in structure from the last three pairs. They arise from the middle or even the anterior portions of the segments and in them the dactyl is backwardly directed, whereas the three more posterior appendages are longer, arise from the posterior region of their related segments and show the dactyl forwardly directed.

The *fifth, sixth and seventh peraeopods* are similar to one another, but each is longer and proportionately larger in all its parts than the preceding limb. The seventh, the last of the posterior series of three, is approximately 1⅓ the length of the longest of the limbs of the anterior series.

The *pleopoda* are large and well developed. There are five pairs, all branchial in function and hanging vertically from the ventral surface wholly unprotected by pleura. In this respect *Hyperoedesipus* resembles *Phreatoicoides* and *Hypsimetopus* and differs markedly from *Phreatoicus*.

The *first pleopod* (Pl. V, 16). The protopodite is sub-rectangular in outline and, like the narrow elliptical endopodite, is wholly devoid of setae. The exopodite, also elliptical in shape, is 1½ the length of the endopodite and about twice its breadth. The margin is entire and is fringed with long plumose setae, only a few (three or four) at the proximal end being simple.

The *second pleopod* (Pl. V, 17). The protopodite is larger and stouter than in the preceding limb and bears distally, on its inner margin, a number of setae, some of which are short and hooked. The endopodite is attached by a thick peduncle from which, in the male, arises the penial filament. This is a narrow, almost sickle-shaped process tapering to a point, much as in *Phreatoicoides*, but bearing at its extremity two very long simple setae. The exopodite is more or less oblong and has a smaller lobe arising towards its distal end projecting freely beyond the main lobe. The margin

is closely set with long setae, all of which are plumose with the exception of those few situate on the short inner margin. In the female this appendage is similar but lacks the penial filament.

The *third, fourth and fifth pleopoda* are generally alike, but decrease in size gradually from the third to the fifth. The so-called epipodite found in *Phreatoicus, Phreatoicopsis* and *Hypsimetopus* is absent in *Hyperoedesipus*, which thus resembles *Phreatoicoides* alone of the described *Phreatoicidae*. The endopodite decreases in size until, in the fifth pleopod, it is about one-third only of the length of the exopodite, which in this limb is relatively much broader (cf. *Hypsimetopus*) and has the terminal lobe distinctly smaller. The margins are fringed with long setae which are plumose, with the exception of those on the inner margin and a few on the outer proximal margin.

The *uropoda* (Pl. V, 10, 11) are strongly developed. The peduncle stretches considerably beyond the telson, and the lower margin is slightly curved upwards and sparsely setose. The upper margin is markedly serrated and bears a few setae. The outer ramus is two-thirds the length of the peduncle, is styliform, ending in an acute point, and bears numerous spiniform setae. The inner ramus arises from the dorsal surface of the peduncle and is slightly longer and thicker and curved inwards almost to meet its fellow of the opposite side. In life, however, the uropods are carried outwardly, directed at an angle of about 45° to the long axis of the body, and suggest the extended pincers of the earwig.

The solitary gravid female (Pl. III.) taken, measures 6 mm. in length and has a well developed incubatory pouch. This occupies the region beneath the segments 1-5 of the peraeon and extends ventrally to the distal extremity of the ischium of the third peraeopods. It appears to be formed by three pairs of thin transparent lamellae (oostegites) which arise from the inner side of the basal joints of the third, fourth and fifth pairs of peraeopods and overlap to enclose a spacious chamber in which the eggs are carried. In the figure the first pair of oostegites seem to have been displaced ventrally, the lamellae having probably been loosened. The lamellae are sub-spherical in outline, much as in *Phreatoicoides*, with entire convex margins.

Sexual differences. The adult female is distinctly smaller than the male and, in addition to bearing the incubatory pouch, differs externally in the following characters:—First peraeopod lacking the well developed clasping hand, fourth appendage not modified to form a grasping organ, second pleopod without a penial filament.

EXPLANATION OF PLATES.

II.

1a.—Lateral view of *Hyperoedesipus plumosus* (male). Only the appendages of right side shown with the exception of the pleopods and 1st pair of peraeopods.

1b.—Cephalon and adjacent parts enlarged.

a—1st antenna.

a_2—2nd antenna.

Md.—mandible.

Mxp.—maxilliped.

Ppd.—portion of 1st peraeopod.

III.

Lateral view of *Hyperoedesipus plumosus* (female).

IV.

Appendages of *Hyperoedesipus plumosus.*

3a.—1st antenna.

3b.—2nd antenna.

4.—Upper lip.

5.—Left mandible.

p—palp.

mt.—molar tubercle.

6.—1st maxilla.

7.—2nd maxilla.

8.—Lower lip.

9.—Maxilliped.

ep.—epipodite.

ac. l.—accessory lobe.

V.

Appendages and tail-piece of *Hyperoedesipus plumosus.*

10.—Lateral view of tail-piece and uropod.

a.—anal opening.

11.—Dorsal view of same.

12.—1st peraeopod (male).

13.—1st peraeopod (female).

14.—2nd peraeopod.

15.—7th peraeopod.

16.—1st pleopod.

17.—2nd pleopod (male).

pf.—penial filament.

18.—5th pleopod.

All figures drawn with the aid of camera lucida, Plate II, 1a, from a living specimen.

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SYSTEMATIC POSITION OF HYPEROEDESIPUS.

	Hypsimetopus.	Phreatoicopsis.	Phreatoicus.	Hyperoedesipus.	Phreatoicoides.
Ratio of $\frac{\text{Pleon and Telson}}{\text{Cephalon and Peraeon.}}$	$\frac{45}{100}$	$\frac{60}{100}$	$\frac{58 - 63}{100}$	$\frac{53}{100}$	$\frac{36}{100}$
First segment of Peraeon	Equal in length to succeeding segment	More than $\frac{1}{2}$ length of succeeding segment	$\frac{1}{2} - \frac{1}{2}$ as long as succeeding segment	Less than $\frac{1}{2}$ length of succeeding segment	$\frac{2}{3}$ length of succeeding segment.
Constriction between segments 5 and 6 of pleon	Scarcely apparent ...	Not apparent	Not apparent	Slight	Well marked.
Appendages—					
Second maxillae ...	Outer lobes as long as the base	Outer lobes longer than the base	Outer lobes much shorter than the base	Outer lobes not as short as in Phreatoicus but shorter than base	Outer lobes as long as base.
First appendage of peraeon (male)	Palm convex proximally, straight distally, dactyl much shorter than propod	Palm slightly concave, set with spines and bearing a stout tooth, dactyl shorter than propod	Palm convex, dactyl slightly shorter than propod	Palm convex proximally, concave distally, dactyl as long as propod	Palm almost entirely concave, dactyl curved, almost as long as propod.
Fourth appendage of peraeon	Shorter than other peraeopods but not sexually differentiated	Not sexually differentiated	Shorter than other peraeopods, sexually differentiated	Shorter than other peraeopods, sexually differentiated	Not shorter than other peraeopods nor sexually differentiated.
Pleura	Slightly produced ...	As in Phreatoicus ...	Produced to a depth almost equal to that of related segments	Scarcely produced ...	As in Hyperoedesipus.
Pleopods	Exposed. Epipodites on 3, 4, 5. Plumose setae few, penial filament without setae	Hidden by pleura. Epipodites on 3, 4, 5. No plumose setae. Penial filament without setae	Hidden by pleura. Epipodites on 3, 4, 5. Plumose setae present. Penial filament with 4 — 5 short setae	Exposed. No Epipodites. Plumose setae abundant. Penial filament with two long setae	Exposed. No epipodites. No plumose setae. Penial filament without setae.
Uropods	Peduncle $\frac{1}{2}$ length and $\frac{1}{3}$ depth of tail-piece. Rami shorter than peduncle.	Not projecting beyond tailpiece	Peduncle $\frac{2}{3}$ length and $\frac{1}{4}$ depth of tail-piece. Rami shorter than peduncle	Peduncle slightly greater than $\frac{1}{2}$ length and approximately $\frac{1}{3}$ depth of tail-piece. Rami shorter than peduncle	Peduncle almost $\frac{1}{3}$ length and $\frac{1}{2}$ depth of tail-piece. Rami longer than peduncle.